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vened and the institute was devoted to sightseeing and other forms of entertainment in which a majority of the visitors participated, a Thanksgiving dinner being served, which was attended by 175 registrants.

Many of those who attended the institute decided to remain in order to take part in the all-America conference on venereal diseases which followed.

THE DISTRIBUTION OF THE SPORES OF B. BOTULINUS IN NATURE.

By K. F. Meyer, of the George Williams Hooper Foundation for Medical Research, University of California, and J. C. Geiger, Epidemiologist, United States Public Health Service.

A recent compilation of the epidemiological data thus far collected, supplies some interesting facts relative to the frequency and the distribution of botulism in California. Since 1900, 39 human outbreaks, with a probable total of 130 cases and a mortality of 94 cases, or 72.3 per cent, have been recognized. Botulism as an intoxication is, however, not confined to man; thus it has been recognized by Dickson as a malady of the fowl and other domesticated birds and of hogs, and by Graham as a disease of the horse and mule. To the above list, 42 outbreaks of botulism of fowls, 3 of hogs, and 79 outbreaks of so-called "forage poisoning" in horses, which in the majority of instances were probably cases of botulism, could be added, making an approximate total of 163 outbreaks in California.

Having recorded the various cases of botulism by means of a "spot" map, it becomes evident that the disease has, as far as the Pacific coast is concerned, a tendency to a distinct centralization. Some sections of the State, for example, near Los Angeles, showing a concentrated number of horse, fowl, and human cases, deserve, in the future, intensive investigation. The occurrence of botulism cases is not confined to certain districts or counties, but may, in a manner characteristic for soil-borne infections, be restricted to certain streets or sections of a city or village. In fact, the ripe olives that caused the recent outbreaks have been traced to two ranches in widely separated communities. In this connection it is of interest to note that not infrequently forage poisoning cases in horses antedated the observation of human or bird cases. In some of these localities the spores of *B. botulinus* have been demonstrated in decomposed hay, straw, or similar material which served as food for the horses.

Outbreaks among chickens or barnyard birds are always closely connected with the feeding of spoiled vegetables or food, and they are therefore not infrequently associated with human cases. The recognition of the intoxication under the collective term of "limberneck of chickens" serves sometimes as a guide in locating the source of poisoning. This point is best illustrated by a few examples in the study of an outbreak of botulism in chickens in *S.* near San Francisco, in which 643 chickens died in 4 days, following the feeding of garbage consisting of beans and other kitchen refuse. The following facts have thus far been established:

The string beans had been home canned. Four jars were found to be spoiled, exhibiting a bad odor, and their contents were therefore thrown into the garbage. The beans were grown in a vegetable garden heavily fertilized with human excreta. The bacteriological study of the soil revealed the presence of *B. botulinus* spores. The strains isolated are, as far as the available methods permit us to determine, identical with the organisms isolated from the intestines of one of the chickens. The cycle of the infection or intoxication could probably have been fully demonstrated if the jars of home-canned string beans were still available. The evidence, however, seems sufficiently conclusive to indicate that the soil or the dust derived from it contaminated the beans, and spores of *B. botulinus* were introduced into the canned jars. The beans being an excellent medium for the development for this particular microbe, the conditions necessary for the production of botulism poison in the jar were immediately at hand. The feeding of these spoiled vegetables quite naturally led to the fatalities. *The methods of sterilization employed in the home-canning process are not sufficient to kill this resistant form of B. botulinus.* In a similar outbreak (*Kl*) it was possible to demonstrate the presence of *B. botulinus* in the soil, on the bean stalks and the bean husks, and in the crop of the poisoned chicken.

From these observations it is obvious that *B. botulinus* was present in the soil in both instances. Immediately the important question arises as to how *B. botulinus* and its spores get into the soil. The present knowledge concerning soil-borne diseases is rather meager; but it is known that anthrax and blackleg of domesticated animals are quite frequently confined to certain districts and areas. The careless burial of blackleg and anthrax carcasses and the fertilization of land with animal manure are evidently some of the factors which contribute to the pollution of the soil with disease-producing spores. With regard to tetanus it is known that horse manure can harbor tetanus germs, and a number of investigators have demonstrated the fact that certain horses can act as true "tetanus spore carriers." By analogy, one may suspect that the soil of certain parts of the Pacific coast is or has become polluted with botulism spores through the use of manure or other fertilizing material. Some observations made in connection with the outbreak in *Kl* justify this deduction and warrant a very extensive investigation. The facts are briefly as follows:

For eight years previous to 1918 an owner of a small vegetable garden grew and home canned string beans without any spoilage.

In 1918 the garden was fertilized with animal manure. The beans grown during this year were canned by the same method used previously; the contents of the jars promptly spoiled and some contained the botulism poison.

If one begins to associate *B. botulinus* spores with animal manure, an endless chain of problems for investigation suggests itself, particularly when one recalls that Kempner and Pollack recovered in Germany on one occasion *B. botulinus* from the intestinal tract of a hog. A somewhat similar observation has been made by Dickson and Burke, who isolated the organism from the manure of a large hog which had recovered from botulism three months before the specimen was taken. Until the investigations dealing with this aspect of botulism are completed, it is impossible to recite or to surmise the mechanism which leads to a pollution of soil with spores.

Having recognized the soil as a source of *B. botulinus*, it appears logical to suspect that vegetables may be contaminated with spores. This suspicion has been proved to be correct; peas, beets, radishes, asparagus, carrots, parsnips, and string beans, bought in the open market in San Francisco and neighboring towns, revealed by cultural methods the presence of *B. botulinus* spores.

Dickson and Burke have reported the finding of spores on bird-pecked, bruised, and molded cherries, and our tests demonstrate the organisms on bird-pecked apricots, cherries, and unbroken olives on the tree. These laboratory results are confirmed and can well be correlated with some of the epidemiological observations. In 16 outbreaks the goods used for home canning were purchased in the open market. Among the fruits and vegetables which apparently carried *B. botulinus* spores are to be mentioned, pears (one outbreak), beans (seven outbreaks), asparagus (five outbreaks), and apricots (three outbreaks).

In conclusion, it can be stated that the information thus far at hand and briefly sketched in the preceding paragraphs definitely indicates that the spores of *B. botulinus* may be widely distributed in nature in certain localities and that they may be on vegetables or fruits when they are picked or bought in the open market. It is also quite obvious that under these circumstances protection against botulism can be achieved only by sterilization of the food product to be preserved at a temperature above boiling (under pressure) or by cooking the contaminated food before eating, or even better, by discarding any canned vegetable or fruit which shows the least sign of spoilage.